

THE STATUS OF *OPODIPHTHERA CARNEA* (SONTHONNAX) AND *OPODIPHTHERA LORANTHI* (LUCAS) (LEPIDOPTERA: SATURNIIDAE) IN NORTHERN AND EASTERN AUSTRALIA

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Abstract

Opodiphthera carnea (Sonthonnax) and *O. loranthi* (Lucas) are confirmed as separate species, occurring in northern and eastern Australia respectively. Notes are presented on diagnostic characters, aspects of their biology and life histories.

Introduction

The name *Antheraea carnea* Sonthonnax, 1899 has not been widely used in the Australian literature and the identity of the species has been in some doubt. When Turner (1922) revised the Australian Saturniidae he did not include the name and may have been unaware of it. Seitz (1928) used the name and illustrated a specimen (his Fig. 52c) but considered it a form of *Caligula helena* (White). Schüssler (1933) listed the name and followed Seitz in treating it as a form of *Austrocaligula helena*. Bouvier and Riel (1931) and Bouvier (1936) both listed it in the genus *Opodiphthera* Wallengren as a valid species. Edwards (1996), recognizing Seitz's (1928) figure and checking the original description, placed it as a synonym of *Opodiphthera loranthi* (Lucas, 1891), a species well known to Australian lepidopterists. Lane *et al.* (1997) recognized differences between the northern and southern populations of what was then known as *O. loranthi*. D'Abrera (1998) treated *O. carnea* and *O. loranthi* as separate species and illustrated both, although he misidentified two of the three specimens illustrated. The treatment by D'Abrera (1998) led us to re-examine the identity of *O. carnea* and we now consider that *O. carnea* and *O. loranthi* are separate species, which differ in their appearance, morphology, distribution and biology.

Sonthonnax (1899) described *O. carnea*, in a Report of the Commission of the Laboratoire D'Études de la Soie (Laboratory for Studies of Silk), from an unspecified number of specimens of both sexes. He gave the locality as 'Nord de l'Australie' (northern Australia) and referred to a 'type', which we interpret as a holotype, together with specimens in the Rothschild Collection. We have accepted the implication that the holotype was in the collection of the Laboratoire. Bouvier and Riel (1931) listed a single male in the collection of the Laboratoire from Georgetown, Queensland plus five other specimens, including a female labelled 'Australie' and four specimens collected after the original description was published. Bouvier (1936) appended '(Mus. Paris)' to his listing of *O. carnea* and we interpret this to mean that the holotype was then in the Museum National d'Histoire Naturelle, Paris. An enquiry was made on our behalf by the late Dr Ebbe Nielsen to Dr Joel Minet but the type could not be found. Drs Minet, P. Viette and P-C. Rougeot concurred that the

type should be in the museum collection but as it could not be found it should be regarded as lost. Nevertheless, there seems to be some possibility of the holotype being found and we have refrained from describing a neotype.

The original description of *O. carnea* was reasonably detailed and Sonthonnax (1899) mentioned 'two forms' and also 'intermediates'. The mention of two forms suggests that Sonthonnax described both species originally but we do not know what he meant by 'intermediates'. In the absence of the holotype of *O. carnea* we interpret this species on the basis of its distribution, representing the northern species, found in northern Queensland and the Northern Territory. *O. loranthi* is the more southern species, found in central and southern Queensland, New South Wales and the Australian Capital Territory. However, it should be noted that the rather crude illustration provided by Sonthonnax (1899) is a better representation of *O. loranthi* than of *O. carnea*. Should the holotype of *O. carnea* be found in the future then the question of its identity may need to be revisited.

Lucas (1891) described *Antheraea loranthi* from an unspecified number of specimens (there were many) from 'Brisbane to Duarina, Qld'. A specimen in the Lucas collection in the South Australian Museum, labelled 'Brisbane Lucas coll.' and '*Antheraea loranthi* Lucas TYPE I 14346 Id by N. Tindale probably type', is certainly one of the syntypes and is here designated as Lectotype in order to stabilize the name for future studies. A photograph of this specimen has been examined and it is the species we here call *O. loranthi*, which was first placed in *Opodiphthera* by Bouvier (1936). Lucas (1891) gave some information about its biology and more details were given by Common (1990), who also illustrated the larva in colour.

Opodiphthera carnea (Sonthonnax, 1899)

(Figs 1-2, 5-6, 14-16)

Material examined. NORTHERN TERRITORY: 1 ♂, 12.52S 132.50E, Koongarra, 10.iii.1974, M.S. Upton; 1 ♂, same data but 20.ii.1974, J.L. Curtis; 4 ♂♂, 1 ♀, 12.19S 133.19E, Nabarlek, Melanie Webb, with dates 19.iii.1983, 6.iv.1983, 11.xi.1983, 16.xi.1983, no date; 1 ♂, 15.07S 131.42E, 98 km SW of Katherine, 1.iv.1995, E.D. Edwards & M. Matthews (all in Australian National Insect Collection (ANIC), Canberra); 1 ♂, Mahaffey Rd, Howard Springs, 5.iv.1993, D.N. Wilson (in D.A. Lane coll.); 1 ♂, Howard Springs, 25.iv.1995, C.E. Meyer, D.A. Lane & D.N. Wilson (in C.E. Meyer coll., Canberra). QUEENSLAND: 1 ♂, 15.11S 144.25E, 7 km ESE New Laura, Lakefield Nat. Pk, 27.vii.1998, E.D. Edwards; 1 ♂, 15.13S 143.55E, 5 km SE Hann River, 15.i.1994, E.D. Edwards & P. Zborowski; 2 ♂♂, 15.16S 144.49E, 14 km WbyN Hope Vale Mission, 9.x.1980, E.D. Edwards; 1 ♂, 15.18S 145.01E, 31 km NWbyN Cooktown, 20.v.1977, I.F.B. Common & E.D. Edwards; 1 ♂, 15.30S 145.16E, 5 km SEbyS Cooktown, 19.v.1977, I.F.B. Common & E.D. Edwards, ANIC genitalia slides 13106, 13107; 2 ♂♂, 15.45S 144.15E, 2 km NNW Jowalbinna, 17.i.1994, E.D. Edwards & P. Zborowski; 1 ♂, 17.01S 145.35E, Davies Creek Nat. Pk, 22.ii.1998, E.D. Edwards & H. Sutrisno; 1 ♂, 18.07S 144.49E, Forty Mile Scrub, 1.xii.1970, R. Hardie; 2 ♂♂, same data except date 17.ii.1998 and collector R.

Oberprieler; 1 ♀, Townsville, 5.xi.1900, F.P. Dodd; 1 ♀, same locality without further data; 1 ♂, 20.30S 144.50E, 5 km S Warang Camp, White Mts, 6.iv.2000, E.D. Edwards (all in ANIC); 8 ♂♂, 4 ♀♀, 12 km N Atherton, bred/pupa, 22.x.1999, 12,19,21,24.xi.1999, 18,20.xii.1999 & 3,5,15,18.i.2000, D.A. Lane; 8 ♂♂, 3 ♀♀, 10 km N Atherton, bred/pupa, 22.xii.1993, 26,28.x.2003, 8,20,22,25.xi.2003 & 4,8,9,10.xii.2003, D.A. Lane; 14 ♂♂, 8 ♀♀, 30 km NW Atherton, bred/pupa, 1,2,4,5,7.x.2000, 22,23,25.xi.2000, 2,4,6.xii.2000, 16.ii.2001, 19.iii.2001, 29.x.2003 & 2,6,8,12,13,26.xi.2003, D.A. Lane; 1 ♂, 4 ♀♀, 20 km W Mt. Surprise, 18.21S, 144.15E, bred/pupa, 28.x.2003, 9,11.xi.2003 & 8,10.xii.2003, D.A. Lane; 1 ♂, Townsville, bred/pupa, 27.vii.2001, S.J. Johnson; 2 ♂♂, Bogie R., 96 km W Bowen, 29.xi.1970, D.A. Lane (all in D.A. Lane coll.); 1 ♂, Cooktown, ii.1991, Bernard Turlin, genitalia slide SNB 925/03 (in S. Naumann coll., Berlin).

Male genitalia (Figs 5-6). Uncus fairly narrow, angled downwards, tip bifurcate with two down-pointed teeth; tegumen broad, arched; vinculum broad; saccus broad, curved anteriorly; valva short, very broadly triangular, with a bluntly pointed tip, a large subspherical projection from near the base of the costa, with one long pointed projection and several rounded protrusions; aedeagus short, broad, tip slightly notched.

Distribution. *O. carnea* is known from the Northern Territory at about 100 km SW of Katherine, from the Darwin area, Kakadu National Park and western Arnhem Land. In Queensland it is known from Lakefield National Park, from Cooktown, then south through the western Atherton Tableland to Townsville and inland to Forty Mile Scrub, from near Georgetown and Mt. Surprise, the White Mountains and from an area 96 km west of Bowen.

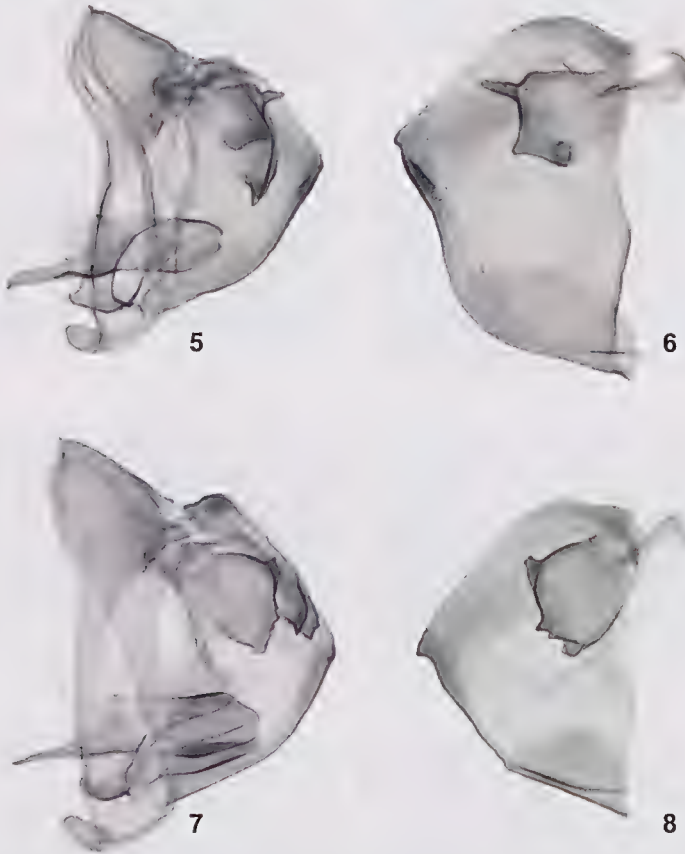
Life history and biology. The foodplants are pendulous mistletoes belonging to the genus *Amyema* (Loranthaceae), often *A. miquelii*, growing high on eucalypt trees. The egg is of the flat type, ovoid in shape, 2 mm x 1.5 mm x 1 mm high, creamy white, laid in batches of 3-20 on stems or (less frequently) leaves of the foodplant. First instar larva 4 mm long when first hatched; head and legs black, body mostly black with light tan markings; covered in fine black setae mostly arranged on scoli. Second instar larva 10-25 mm long; head and legs black; body light brown, with darker brown markings and black setae. Third instar larva (Fig. 14) 25-40 mm long; head black, ocelli dark brown; prothoracic plate very dark brown, almost black, with rows of white setae extending forward, looking superficially like human eyelashes; legs and prolegs dark brown, also adorned with white setae; spiracles distinctly white, surrounded by dark brown rings; body light creamy-brown, adorned with raised scoli which are basally dark brown becoming rose pink distally and adorned with a whirl of white setae at the top; the scoli on each segment are joined by a dark brown band, giving a banded appearance. Fourth instar larva 40-70 mm long; similar to fifth instar, but body is light brown in ground colour. Fifth instar larva (Figs 15-16) 70-120 mm long; head and ocelli black, with fine white setae; legs black, covered in fine white setae; upper part of legs adorned with white spatula-like setae; body bright green,



Figs 1-4. *Opodiphthera* spp., uppersides. (1-2) *O. carnea*: (1) female; (2) male. (3-4) *O. loranthi*: (3) female; (4) male.

same colour as mistletoe leaves, providing remarkably good camouflage for such a large larva; each thoracic and abdominal segment ringed by a black band that straddles spiracles, extending up from the legs; each black band contains raised scoli coloured rose pink; tips of scoli bear a white, spoon or spatula shaped seta; white setae also straddle the body on each side of the

black bands; spiracles distinctly white; a lateral row of scoli occurs below spiracles; abdominal segments 1-6 carry four scoli above spiracles; anal segment also carries four scoli; anal segment and prolegs black, covered in white setae; anal plate dark brown, with fine white setae.



Figs 5-8. *Opodiphthera* spp., male genitalia. (5-6) *O. carnea*: (5) lateral view with left valva removed, genitalia slide ANIC 13106; (6) lateral view left valva, genitalia slide ANIC 13106. (7-8) *O. loranthi*: (7) lateral view with left valva removed, genitalia slide ANIC 13108; (8) lateral view left valva, genitalia slide ANIC 13108.

Larvae spin their cocoons gregariously in a clump on the mistletoe butt, with individual clumps of 3-40 cocoons being found. Individual cocoons are quite tough and rigid. The cocoon clump, however, usually has an outer layer of silk, slightly detached from but attached to the cocoons, slightly loose and covering the cocoon clump like an outer wall. This outer silk layer is often

similarly coloured to the mistletoe branches, providing remarkably good camouflage. Adults usually emerge from their cocoons after 2200 h and may not fly until 2300 h or later. The habitat in which this species occurs is the drier open eucalypt woodland of the northern savannah country, where good quantities of *Amyema* mistletoes occur.

***Opodiphthera loranthi* (Lucas, 1891)**

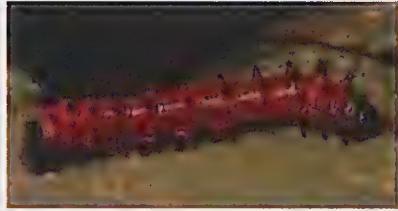
(Figs 3-4, 7-13)

Material examined. QUEENSLAND: 1 ♀, 21.02S 149.10E, Bucasia, 17.ix.1995, K.J. Sandery; 1 ♀, Marmor to Bajool, Bruce Highway, 16.iii.1995, G. Clarke; 1 ♂, Duaringa, 17.x.1919, 1 ♀, same locality, 22.x.1919; 1 ♂, Gayndah; 2 ♀♀, Noosa, 16.ii.1967, V.J. Robinson; 1 ♂, Toowoomba, 30.xii.1927, W.B. Barnard, 2 ♀♀, same data except dates 25.xii.1927, 30.xii.1927; 1 ♂, Toowoomba, 1.ii.1963, J. Macqueen; 1 ♂, 27.33S 151.59E, Prince Henry Heights, Toowoomba, 15.i.1983, I.F.B. Common, 1 ♂, same data except 16.ii.1993; 1 ♂, Brisbane, [A.J. Turner]; 1 ♀, Brisbane, 12.ii.1928, A.N. Burns; 4 ♂♂, 3 ♀♀, Brisbane, 9.i.1955, 10.i.1955, 12.i.1955, 15.i.1955, C. Franzen; 3 ♂♂, 1 ♀, Millmerran, 15.i.1956, 1.ii.1956, 3.ii.1956, 4.ii.1956, J. Macqueen; 1 ♀, Glen Aplin, 10.xii.1948, Jean Gemmell; 2 ♂♂, 3 ♀♀, Stanthorpe, 23.xi.1927, 24.xi.1927, 25.xi.1927, 29.xii.1927, 4.ii.1928, W.B. Barnard; 2 ♂♂, Killarney, 9.ii.1928, 12.ii.1947, W.B. Barnard; 6 ♂♂, 5 ♀♀, Killarney, no date, 5.xii.1933, 7.xii.1933, 12.ii.1944, 5.xi.1944, 26.xi.1944, 8.xii.1944, E.J. Dumigan (all in ANIC); 1 ♀, Dawson River; 1 ♂, Chambers Flat, 6.xii.1992, R. McDonald; 1 ♂, Toowoomba, 1.i.1928, W.B. Barnard; 1 ♀, Brisbane, xi.1927, H. Hacker; 1 ♂, Tamborine Mt, i.1956, G. King; 4 ♂♂, 2 ♀♀, Killarney, 29.xii.1927, 11.i.1928, 13.i.1928, W.B. Barnard (all in Queensland Museum, Brisbane); 4 ♂♂, 4 ♀♀, Toowoomba, bred/pupa, 20.21.xii.1974, D.A. Lane; 2 ♂♂, 2 ♀♀, Leyburn, bred/pupa, 2.iii.1977, 2.25.xi.1977, 26.xii.1977, D.A. Lane; 1 ♂, Ravensbourne, 23.xii.1979, D.A. Lane (in D.A. Lane coll.). NEW SOUTH WALES: 2 ♂♂, Sheep Stn Ck, Border Ranges Nat. Pk, 5.ii.1999, E.D. Edwards; 1 ♂, 7 mls W Rosebank, 8.xi.1961, I.F.B. Common & M.S. Upton; 2 ♂♂, Dorrigo Nat. Pk, 17.xi.1976, I.F.B. Common & M.S. Upton; 1 ♂, 1 ♀, Entrance, New England Nat. Pk, 26.xii.1960, 5.ii.1962, C.W. Frazier, male with ANIC genitalia slides 13108, 13109; 1 ♂, O'Sullivan's Gap, 15.xi.1976, I.F.B. Common & E.D. Edwards; 1 ♂, Caparra, 2.i.1992, J. Stockard; 1 ♀, Narara, 3.x.1949, L.H. Mosse-Robinson; 1 ♂, Gosford, 20.iii.1952, L.H. Mosse-Robinson; 1 ♂, Otford, 17.xii.1962, V.J. Robinson; 2 ♂♂, Mt Keira, 29.xi.1977, 1.xii.1979, V.J. Robinson; 1 ♂, Wirrimbirra Picton, 30.xi.1967, V.J. Robinson; 1 ♂, Minnamurra Falls, 18.i.1969, V.J. Robinson; 1 ♂, 1 ♀, Bawley Point, 3.x.1997, 3.xii.1997, D.C.F. Rentz; 1 ♀, Cochranes Flat, 9 km SW Eden, xii.1999, L. Simpson (all in ANIC); 1 ♀, Inverell, xii.1977, J.I. Giddings (in D.A. Lane coll.). AUSTRALIAN CAPITAL TERRITORY: 1 ♂, Canberra env., Gympie St lantern, 8.xi.1983, Dirk Casteleyn, genitalia slide SNB 926/03 (in S. Naumann coll., Berlin).

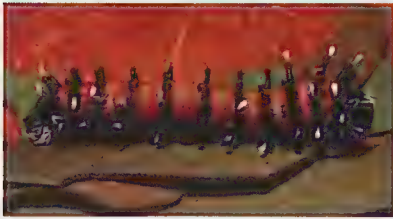
Male genitalia (Figs 7-8). Uncus fairly narrow, angled downwards, tip bifurcate with two down-pointed teeth; tegumen broad, arched; vinculum broad; saccus broad, curved anteriorly; valva short, very broadly triangular, with a bluntly pointed tip, a large subspherical projection from near the base of the costa, with four short blunt projections of about equal size; aedeagus short, broad, tip slightly truncate.



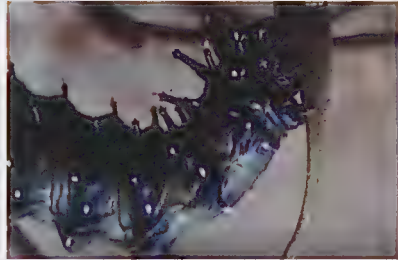
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Figs 9-16. *Opodiphthera* spp., larvae. (9-13) *O. loranthi*: (9) first instar; (10) second instar; (11) fourth instar; (12-13) final instar. (14-16) *O. carnea*: (14) third instar; (15-16) final instar.

Distribution. *O. loranthi* is known from Bucasia in northern central Queensland south along the coast and tablelands to Cochranes Flat south of Eden, NSW (where it has recently been reared by Mr Lewis Simpson) and from Canberra, ACT.

Life history and biology. At Toowoomba and Leyburn larvae of *O. loranthi* utilize *Amyema miquelii* (pers. obs. DAL). Recorded fooplants are *A. miquelii* (Hagan 1983), *A. pendula* (V.J. Robinson and L. Simpson, pers. comms) and *A. quandang* (J. Macqueen, label data). First instar larva (Fig. 9) with head and legs shiny black; body light brown; abdominal segments 1, 6, 7 and anal segment black; each segment carries raised light brown scoli - those on abdominal segments 1, 6, 7 and anal segment are black in colour; each scoli carries an upper whorl of brown setae. Second instar larva (Fig. 10) similar to first instar but body entirely light brown; scoli brown with black upper tips. Fourth instar larva (Fig. 11) with head, legs and anal segment black; head and prothoracic plate with white setae; body light brown; each segment is ringed by a narrow black band that extends up from legs; anal prolegs adorned with scattered white setae; scoli black, adorned with irregularly scattered white setae. Fifth instar larva (Figs 12-13) with head, prothoracic plate and legs black, carrying scattered white setae; body olive green; each thoracic and abdominal segment ringed by a broad central black band that extends up from legs; each black band contains raised scoli, black in colour, which are adorned with scattered white setae on tips; spiracles white.

Larvae pupate in a cluster of cocoons on the mistletoe butt, with aggregations of pupae ranging from three to forty having been found. Individual cocoons are quite tough and rigid and, like *O. carnea*, are also enclosed in a slightly detached silk layer, also coloured like the mistletoe branches and giving excellent camouflage. The habitat of *O. loranthi* is the open eucalypt woodland of central Queensland and New South Wales.

Discussion and comparison

Larvae of both species are fairly similar, although noticeable differences in the various larval instars, particularly the final, are evident. The final instar larva of *O. loranthi* (Figs 12-13, locality Toowoomba, Qld) shows distinctive differences from the final instar larva of *O. carnea* (Figs 15-16, locality 30 km NW Atherton, Qld). In *O. loranthi* the base colour is a much darker green, almost greyish. The raised scoli stems are black in colour, matching the black body bands, as opposed to the rose-pink scoli stems of *O. carnea*. The black segmental bands of *O. loranthi* are wider than those of *O. carnea* and also do not have the white adjacent setae present in *O. carnea*. The anal plate of *O. loranthi* is also a much lighter brown colour than in *O. carnea*.

We have not seen specimens from the area west of Bowen in the north to Bucasia (north of Mackay) in the south. It is not known if this area represents a gap in distribution between the two species, whether they overlap in this area, or if they are allopatric.

Sonthonnax (1899) gave a reasonable description of *O. carnea* but it lacked the diagnostic features needed to distinguish it from *O. loranthi* and the illustration given was too crude to be reliable. *O. carnea* was illustrated in colour by Seitz (1928) and was correctly identified but Seitz did not illustrate *O. loranthi*. *O. loranthi* was correctly illustrated in black and white by Common (1990, Fig. 40.8). The best coloured illustrations of adults available are those of D'Abrera (1998) but two of these were misidentified: the male figured opposite p. 22 is *O. loranthi* and not *O. carnea* as stated; the female opposite p. 22 is *O. carnea* and is correctly identified; the male figured opposite p. 26 is *O. carnea* and not *O. loranthi* as stated.

On the forewings of both sexes the postmedian band is more heavily marked in dark grey proximally in *O. carnea* and is a little more parallel to the termen and closer to the termen when it reaches the dorsum in *O. carnea* than in *O. loranthi*. If the inner margin of this postmedian band is well defined as it curves near the costa, then it is smoothly rounded in *O. carnea* and slightly waved in *O. loranthi*. It is more usually well defined in *O. carnea*. Also, on the forewings of both sexes the subapical black spot is larger in *O. carnea*. On both wings the eyespots are generally larger in *O. carnea* than in *O. loranthi* and have darker red-brown centres. The black outer crescent of the forewing eyespot is broader in *O. carnea* and is margined on the inner side by a fine white line. This white line is absent in *O. loranthi*. The forewing termen is less concave in *O. carnea* than in *O. loranthi*. The hindwing postmedian band is usually more clearly defined in both sexes of *O. carnea*.

Males of *O. carnea* range from reddish orange to mustard yellow while males of *O. loranthi* are almost always reddish orange and only very rarely mustard yellow. Females of *O. loranthi* are reddish orange while those of *O. carnea* are consistently paler and more reddish yellow. On the underside of both wings of *O. carnea* the postmedian line is a broad band of scattered black scales, ill defined but well developed and reminiscent of the postmedian band on the upperside of *O. engaea* Turner. On the underside of *O. loranthi* the postmedian band is usually absent, sometimes very vaguely defined on the forewing but in the hindwing is usually represented by a very vague area of paler and pinker scales than the ground colour.

The white line on the inner margin of the outer black crescent of the forewing eyespot in *O. carnea* is perhaps the easiest distinguishing character to use in initially sorting specimens.

The male genitalia of the two species are similar but differ in the form of the subspherical projection from near the base of the costa of the valva, which in *O. carnea* is more squared and has one long projection and several short rounded lumps, while in *O. loranthi* it is more rounded and has four short blunt projections. The tip of the aedeagus differs slightly, being notched in *O. carnea* and truncate in *O. loranthi*.

Conclusion

Noticeable, consistent differences in adult wing pattern and shape, together with differences in male genitalia and larval morphology, confirm the separate status of these two species. With further collecting the distributions will probably be found to be more extensive, particularly that of *O. carnea* across northern Australia.

Acknowledgements

We thank Chris Burwell (Queensland Museum), Stefan Naumann (Berlin), Dave Wilson, Cliff Meyer and Steve Johnson for the donation of, or access to specimens in their care. Garry Sankowsky, Andreas Zwick and Steve Brown offered much assistance with larval photographs. Vanna Rangsi (ANIC) provided the genitalia images. We also thank the Queensland Parks and Wildlife Service for scientific permits allowing research within National Parks and State Forest areas under their jurisdiction.

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